4786

NATIONAL RESEARCH CORPORATION

EQUIPMENT DIVISION

CAMBRIDGE 42, MASSACHUSETTS
U. S. A.

4785

4786
(portable)

OPERATING INSTRUCTIONS

THERMOCOUPLE AND EMISSION REGULATED ION GAUGE CONTROL TYPE 07-1031-01

SERIAL # 63428

NATIONAL RESEARCH CORPORATION

CAMBRIDGE 42, MASSACHUSETTS

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Drawings:

M-18050 Wiring Diagram
M-18049 Panel & Chassis Controls

PWP:ml
Revised 27 June 1952

PHYSICAL AND OPERATING SPECIFICATIONS

for

THERMOCOUPLE AND EMISSION REGULATED ION GAUGE CONTROL TYPE 07-1031-01

Chassis Serial No. 63429

Physical Specifications

Control Unit:

Size: 11-13/16'' x 13'' x 9-3/8''

Weight: 30 lbs.

Finish: Stainless steel etched panel and blonde oak

Cables:

2 - 10 ft. Thermocouple cables
1 - 10 ft. Special ion gauge cable

Power:

115 volts 50/60 cycle, approximately 100 watts

Shipping Weight:

70 pounds

Recommended Gauges:
(not included)

2 Type 05-0100 Thermocouple gauges
1 Type 05-0700 Ionization gauge

Use with other Gauges:

See Section III-C-10

Revised 4 February 52

Operating Characteristics

Ionization Gauge Circuit:

Output Range for Air

(a) 5×10^{-3} mm to 1×10^{-8} mm in five linear scales

0 to 5×10^{-3} mm Hg. full scale
0 to 1×10^{-3} mm Hg. full scale
0 to 1×10^{-4} mm Hg. full scale
0 to 1×10^{-5} mm Hg. full scale
0 to 1×10^{-6} mm Hg. full scale

(b) Emission Regulation:

Automatic regulation at filament emissions of 1, 5, or 10 milliamperes.

(c) External Control Circuit:

One common set of normally open and normally closed contacts rated at 3 amps, 115 volts.

Thermocouple Gauge Circuit:

Range for Air:

Indicates 10^{-3} to 1 mm Hg. on one scale non-linear.

SECTION I

DESCRIPTION OF THE TYPE 07-1031-01 GAUGE CONTROL

A. GENERAL

In the operation of a high vacuum system employing diffusion pumps the hot filament ionization gauge is the most sensitive instrument for measuring pressures in the range below approximately one micron. (1 micron = 1×10^{-3} mm mercury absolute pressure). It is impossible to operate this gauge at high pressures without detrimentally affecting its life. A different type of gauge is required to indicate pressures above approximately one micron and also to indicate when it is safe to turn on the ionization gauge. The Type 07-1031-01 gauge not only reads the output of an ionization gauge, but also reads the outputs of two thermocouple gauges. A typical gauge installation in a vacuum system may be as follows:

1. A thermocouple gauge in the foreline connection of the diffusion pump to indicate foreline pressure.

2. A thermocouple gauge in the high vacuum side of the diffusion pump to indicate roughing pressure and to indicate when the pressure is low enough to turn on the ionization gauge.

3. A hot filament ionization gauge in the high vacuum side to indicate the operating pressure.

The ionization gauge circuit employs the additional feature of constant regulation of the input to the gauge so that readjustment of the input is not necessary after it has been initially set. This means that the effects of temperature, pressure and other factors which tend to change the emission are automatically compensated for by the circuit. As a result, constant pressure readings may be taken without fear of erroneous results due to changing input. The design of the Type 07-1031-01 gauge includes:

1. Two thermocouple gauge circuits with input cutout switches so that neither, either, or both gauges may be operative.

2. An emission regulating ion gauge circuit with grid emission values of one, five and ten milliamperes, adjustable over small intervals about these values.

3. A D.C. amplifier which gives full scale measurements of ion currents corresponding to pressures of five microns, one micron, 1/10 micron, 1/100 micron and 1/1000 micron of mercury, when used with a gauge such as NRC Type 05-0700 which has a sensitivity of approximately 100 microamperes per micron at 5 ma emission.

4. A high pressure cutout in the ionization gauge filament circuit which automatically turns off the gauge if the pressure exceeds approximately 1-1/2 times the full scale reading on any scale.

5. External control connections interlocked with this filament relay which may be used to control diffusion pumps, valves or other devices.

6. One instrument meter which has two scales ; (a) the upper scale calibrated in tenths from zero to one (0 to 1) for use in reading the thermocouple gauge input, the ionization gauge grid currents and the ionization gauge output from the D.C. amplifier, and, (b) the lower scale calibrated in microns of mercury absolute from 1000 microns to 1 micron for use in reading the thermocouple gauge output.

B. DESCRIPTION OF THE FRONT AND REAR CONTROLS

Referring to Figure I, (M-8303), the front panel control functions are as follows: (Encircled numbers refer to those on Figure I)

(1) METER SELECTOR

This switch moves the meter circuit to each of its designated positions, namely; TC-1, TC-2 (thermocouple gauge outputs), TC FIL (input current to heaters of both thermocouple gauges), ION GRID (ionization gauge grid current), and ION PLATE (the amplified ionization current.)

(2) GRID CURRENT

This switch has the function of selecting the values of emission current (ion gauge grid current) desired at 1, 5, or 10 ma.

(3) EMISSION ADJUST

This control is used to set the emission regulated grid current to the exact values indicated on GRID CURRENT switch (2). When using this control, the METER SELECTOR (1) must be in the ION GRID position in order to read the emission current on the meter. Under these conditions the top meter scale markings of 0 to 1 represent 0 to 10 milliamperes grid current.

(4) ION RANGE

This switch selects the correct amplifier output for the ion gauge pressure range being measured. Its steps correspond to full scale reading (using the top meter scale) of 5×10^{-3} mm, 10^{-3} mm, (1 micron), 10^{-4} mm, 10^{-5} mm, and 10^{-6} mm mercury when the grid emission is set at 5 milliamperes. (For gauges having sensitivities other than the NRC Type 05-0700, these full scale readings should be converted to new values determined by the sensitivity of the other gauge. (See Section III-C-10.) The CAL position is used to check the meter sensitivity adjustment, (a setting made at the factory) when the amplifier is balanced. (See Section III-C-4.)

(5) RUN-OUTGAS SWITCH

This switch is used in the ionization gauge circuit and allows the filament transformer to be used for heating the gauge for outgassing as well as to feed the filament of the gauge in the RUN position. This switch is used to turn the gauge off.

⑥ ION START - ZERO SET

This pushbutton is used to energize the ion gauge filament circuit. The RUN-OUTGAS switch ⑤ must be in run. Pushing it energizes the control relay which turns the ion gauge filament on. It is also used to restart the gauge filament whenever the overload relay has cut out. This happens whenever the pressure in the gauge has risen to a value of approximately 1-1/2 times the full scale value chosen with the ION RANGE switch ④ It will not turn on the filament supply to the ion gauge until the ION RANGE switch ④ is in such a position that the pressure in the gauge is less than 1-1/2 times the full scale value indicated. For this reason, it is wise to start the gauge by pushing the pushbutton ⑥ with the ION RANGE switch ④ in the 5×10^{-3} position. This switch is also used to zero set (balance) the amplifier when used in conjunction with the ION ADJUST ⑧ control, and with the RUN-OUTGAS switch in RUN.

⑦ ON-OFF

This is the line switch to the Type 07-1031 Control. Power is applied by moving it to the up or "ON" position.

⑧ ION ADJ

This control is used to balance the DC amplifier output to zero as indicated on the meter when pushbutton ⑥ is pushed in with the ion gauge filament on. This control is always checked when taking accurate pressure measurements, and is done on each scale, i.e. if readings are being taken on the 10^{-5} scale, the amplifier should be balanced with the ION RANGE switch ④ on the 10^{-5} scale.

⑨ TC ADJ

This control is used to adjust the thermocouple gauge filament current to the correct hundredth of an ampere as stamped on the Type 05-0100 thermocouple gauge. This adjustment is made with the METER SELECTOR ① on the TC FIL position. The top scale of the meter will then read the input current in amperes. (See Section III-B.)

⑩ SENSITIVITY

This control adjusts the meter circuit sensitivity when the METER SELECTOR ① is in the ION PLATE position and the ION RANGE switch ④ is in the CAL position. The meter reading is then set

to the value marked at the rear of the chassis over this control. It has been set at the factory and should not need readjustment. (For a check of the setting see Section III-C-4.) With the ION RANGE switch (4) in the CAL position, a calibrating voltage of about 0.7 volts is impressed on the input to the DC amplifier for calibration. The exact value of the calibrating voltage has been measured and stamped on the back of the chassis.

(11) & (12) TC-1, TC-2

These four-prong receptacles with switches below are used with thermocouple gauges 1 and 2. The switches are for shorting out the filaments of the respective gauges in case one is burned out or not connected. In order to use one thermocouple gauge alone, the other TC filament switch must be short-circuited "ON" - (handle to the right looking from rear) as the filaments are connected in series.

(13) ION GAUGE

This receptacle is for connection to the special ion gauge cord and the ion gauge on the vacuum system. The special cord was designed primarily to reduce insulation leakage on the 10^{-6} scale.

(14) RELAY

This receptacle is for connection to auxiliary equipment to be operated in synchronism with the overload relay in the ion gauge filament circuit. Whenever power is supplied to the ion gauge filament, 110 volts AC, 1 ampere is available at terminals 2 and 4 on this receptacle.

If the vacuum process being measured is to be protected against high pressure, this electrical supply may be used to operate relays or valves. If, for example, a process is to be open circuited when the pressure exceeds 1-1/2 times the full scale pressure on a specific scale of the ION RANGE selector (4) this switch (4) is put on the specific range and the 110 volt supply is connected with relays controlling the process. Wiring of the connections is shown on the wiring diagram Figure II. There are also two connections on this receptacle for the addition of a recorder to the instrument. For recorder applications, see special instructions Form #6078.

(15) OPERATION WITH LONG CORDS

The Type 07-1031 Gauge may be modified to be used with cords ranging in length up to 60 feet. It will be found that without this modification that the grid emission is not readily obtained when using long cords.

In this application, a switch is installed in the ionization control, and is located on top of the chassis at the right rear (looking from behind). This switch shunts resistor R-11, shown on the wiring diagram, Figure II.

Operation of a Type 07-1031 control with a long cord to which this switch has been added merely requires switching to the position labeled LONG.

During outgassing, when using a cord longer than ten feet, the grid may not glow as brightly as with a standard cord. However, the gauge still can be properly outgassed if the instructions under Section III-C-2 are followed.

SECTION II

INSTALLATION

A. CONTROL PANEL LOCATION

Place the control panel in a convenient position for reading the meter and operating the gauge. It should be placed so that its base is in a horizontal plane and in such a location that it is subject to minimum vibration. Protect it from contamination from water, oil sprays, acetone, etc.

B. CONNECTIONS

1. Thermocouple Gauges

   a. Install a NRC Type 05-0100 thermocouple gauge in the vacuum system. Be sure gauge is tight by sealing threads with Celvacene or Glyptal (in systems down to 10^{-4} mm) or wax (below 10^{-4} mm). The gauge has 1/8" ips threads.

   b. Connect thermocouple gauges to control unit by means of the four-wire cords provided.

2. Ionization Gauge

   a. Install a NRC Type 05-0700 ionization gauge in the vacuum system by fusing directly to glass system, or by using a NRC Type 13-2200-12 Universal Vacuum Seal for metal systems. It also may be waxed with Apiezon or De Khotinsky wax to a system of either glass or metal.

   b. Connect the ionization gauge to the control unit by means of the special five-conductor cable provided. Care should be exercised when connecting the pin connectors to the gauge so as not to crack the gauge. The markings on the gauge should match those on the cord tips.

3. Power Supply

   Connect the power cord to any 110-volt 50/60 cycle AC standard light receptacle. The gauge draws approximately 100 watts.

SECTION III

OPERATION OF CONTROLS

A. PRELIMINARY

Turn the power switch (7) ON for operation of either of the thermocouple gauge circuits, or the ionization gauge circuit. Allow the instrument to warm up for at least a minute before operating any control.

B. THERMOCOUPLE GAUGE OPERATION

1. For each thermocouple gauge connected to the control, its respective filament switch (11) or (12), just under the cord receptacle should be in the OFF position. If only one thermocouple gauge is used, short-circuit the filament leads of the other gauge receptacle by turning its switch (11) or (12) to the ON position.

2. Turn the METER SELECTOR switch (1) to the TC FIL position. In this position the top scale of the meter reads the filament input current in amperes. Adjust the TC ADJ control (9) to 0.6 amperes plus the number (in hundredths of an ampere) stamped on the stem of the thermocouple gauge; i.e. if the number 4 is stamped on the stem, the thermocouple input current should be set at 0.64 amperes. (See instructions contained in box holding the Type 05-0100 thermocouple gauge.)

3. Turn the METER SELECTOR switch (1) to TC-1 or TC-2 (depending on which thermocouple gauge is being used) and read the pressure in microns of mercury on the lower scale of the meter. This should be done after the gauge has been warmed up for at least 5 minutes. Both thermocouples may be kept warmed at the same time and the input filament current checked periodically as in 3 above.

4. Leak Detection with the Thermocouple Gauge

   Leak detecting may be performed with the thermocouple gauges when pressures are below 200 microns. The procedure is as follows:

   a. Adjust the TC ADJ (9) clockwise as far as possible and set the METER SELECTOR (1) on TC-1 or TC-2, depending on which thermocouple is being used. Best results are obtained when pressures are such that the output reading is more than one-half scale.

b. Spray acetone over the suspected area of the vacuum system and watch the meter very closely. Small rises in the thermocouple gauge indication may indicate a leak which should be eliminated before going on to further portions of the system.

C. IONIZATION GAUGE OPERATION

1. Read the thermocouple gauge. If the pressure in the system is approximately one micron, the ion gauge circuit may be turned on. The gauge should not be turned on at any pressure above five microns for normal operation. The over-pressure relay will not operate to protect the gauge at pressures greater than about 100 microns. If the ion gauge is turned on in this range, the gauge filament may burn out.

2. In order to outgas the gauge, set the RUN OUTGAS switch (5) on OUTGAS. This automatically places the filament voltage across the grid of the gauge. The grid should glow a dull red during outgassing. Outgas the gauge for about five minutes. While the gauge is outgassing, the amplifier will warm up and become stable. Do not outgas for longer than one-half hour.

3. The amplifier should be balanced before pressure measurements are to be taken as follows: Set the METER SELECTOR (1) in the ION PLATE position and the ION RANGE switch (4) in the 5×10^{-3} position, and the RUN OUTGAS switch (5) on RUN. The other controls can be in any position. Push the button (6) and adjust the ION ADJ control (8) so the meter reads zero. This balances the amplifier. For operation on any other range this same procedure should be followed with the ION RANGE switch (4) on the range desired. Whenever ranges are switched, the amplifier should be rebalanced on the new range for accurate readings of pressure.

4. Check the calibration of the amplifier by switching the ION RANGE switch (4) to CAL and the METER SELECTOR (1) to ION PLATE. The meter top scale should read the value marked at the rear of the chassis over the sensitivity control. If it does not, the SENSITIVITY CONTROL (10) at the rear should be adjusted after balancing the amplifier so that it does. This adjustment has been made at the factory and should require no further check, unless components such as tubes or transformers are changed. It is very important that the amplifier be balanced before this sensitivity adjustment is checked.

5. In order to set the grid current, turn the RUN-OUTGAS switch (5) to the RUN position. Set the ION RANGE switch (4) on the 5 x 10^{-3} scale, the GRID CURRENT switch (2) on 5, and the METER SELECTOR (1) on ION GRID. In this setting the meter will read the emission current of 5 milliamperes when the ION START button (6) is depressed. Moving the RUN-OUTGAS switch automatically turns the filament off. (After the switch is turned from run to outgas, to turn the gauge off, return it to run. The switch should not be left in the outgas position for more than one-half hour.) Push the ION START button (6) and set the EMISSION ADJ control (3) so the grid current reads 5 milliamperes or 0.5 on the top scale. (The meter reads 10 milliamperes full scale with the METER SELECTOR (1) in the ION GRID position.) If the control automatically turns the ion gauge off as soon as the button is depressed, the pressure in the gauge may be over 5 microns. Check the thermocouple gauge reading again. If the thermocouple gauge still reads a pressure lower than 5 microns, push the ION START button (6) again. If this still does not turn the gauge on, turn the GRID CURRENT switch (2) to 1, for less emission, and again push the ION START button (6) . After a few minutes at this emission, the gauge filament should be satisfactorily outgassed to operate at 5 milliamperes grid current. Turn the GRID CURRENT switch (2) back to 5 and set the EMISSION ADJ (3) to give exactly 5 milliamperes reading on the meter.

6. Read the pressure at 5 milliamperes emission by turning the METER SELECTOR (1) to ION PLATE and setting the ION RANGE switch (4) to the most sensitive range on which the pressure may be read. This is done by switching it clockwise starting on the 5 x 10^{-3} range. If this operation turns the gauge filament off, switch the ION RANGE switch (4) back (counterclockwise) one range (i.e., if it cuts out going from the 10^{-3} scale to the 10^{-4} scale, retract to the 10^{-3} scale) and push the ION START button (6) . The over-pressure cutout operates on any range the ION RANGE switch (4) is set, and at approximately 1-1/2 times the full scale reading indicated by the setting of the ION RANGE switch (4) . If the meter reads 0.8 with the ION RANGE (4) on the 10^{-6} scale using a NRC Type 05-0700 gauge with 5 milliamperes grid current, the pressure is read as 8 x 10^{-7} mm Hg.

As the output ionization current sensitivity of the NRC Type 05-0700 gauge with 5 milliamperes emission is approximately 100 microamperes per micron pressure, the above reading of 8 x 10^{-7} mm is equivalent to an output from the gauge of 8 x 10^{-2} microamperes or 8 x 10^{-8} amperes. At this amplification, min-

ute leakage current will affect the readings on the 10^{-6} scale. To eliminate this, a shielded plate lead has been incorporated in the design.

7. Turn the ionization gauge filament off by switching the RUN-OUTGAS switch (5) to the outgas position and by returning it to RUN. (Do not outgas longer than one-half hour.)

8. Leak Detection with the Ionization Gauge

Leak detecting with the emission regulated ion gauge control is much simpler than with controls not having automatic regulation. The technique is similar to leak hunting with a thermocouple gauge. Set the ION RANGE switch (4) on a scale such that the pressure reads about half scale on the meter. Spray the system with acetone. When a leak is covered and the vapor has had time to diffuse through the system to the ion gauge, there will be a rise in the indicated pressure because of the greater response of the gauge to this vapor. The emission regulation will maintain the grid current at the value set by the GRID CURRENT switch (2) and the EMISSION ADJ control (3) . For special leak hunting, the two auxiliary emission values of one and ten millamperes grid currents are available. For low pressure readings in the 10^{-6} mm range, the 10 milliampere emission may be used to double the output pressure readings. Set the GRID CURRENT switch (2) on 10, the METER SELECTOR (1) on ION GRID, and adjust the EMISSION ADJ (3) to the full scale value of 1.0 on the top scale. Switch the METER SELECTOR switch (1) to ION PLATE to read the pressure with the ION RANGE switch (4) in the 10^{-6} position. At 1 milliampere emission the pressure readings are one fifth those with 5 milliamperes. For operation near 5 microns, use the one milliampere emission value until leaks are found and remedied.

9. Momentary extension of the pressure range of the NRC Type 05-0700 gauge above 5 microns is possible using 1 milliampere emission. With 1 milliampere emission the 5×10^{-3} scale reads approximately 25 microns full scale. Operation here is not recommended as gauge life is very short and should be used only momentarily.

10. Use with Gauges other than the NRC Type 05-0700

The Type 07-1031 Control is designed primarily for use with the NRC Type 05-0700 gauge, although it can be used with other gauges which lie within the limit of its filament output voltage. This limit is approximately 10 volts AC and therefore cannot be used with aged

gauges requiring voltages over 10 volts to maintain the required emission currents. Operation is similar to that outlined above. With a gauge other than the NRC Type 05-0700 having a sensitivity other than 20 microamperes/micron pressure at one milliampere emission, the pressure ranges indicated on the ION RANGE switch ④ will not be correct. The correct pressure can be computed with the use of a multiplication factor by which the pressure reading should be multiplied to give the correct reading. This multiplication factor is calculated by dividing the sensitivity of the NRC Type 05-0700 gauge by the sensitivity of the other gauge.

For example, if the sensitivity of this gauge were 120 microamperes per micron at 5 milliamperes emission, the multiplication factor would be:

$$\frac{\text{Sensitivity of NRC gauge at 5 mil. emission}}{\text{Sensitivity of other gauge at 5 mil. emission}} = \frac{\text{100 microamps/micron}}{\text{120 microamps/micron}}$$

= 0.833. Pressures read on the 07-1031 Control using this gauge (at 5 milliamperes regulated emission) would be multiplied by 0.833 to get the correct pressure. If the pressure indication were 6×10^{-5} with the other gauge, the actual pressure would be $6 \times 10^{-5} \times 0.833$ or 5×10^{-5} mm Hg. It should be noted that the sensitivities must be specified in the same units (microamperes output per micron pressure) at the same filament emission as the NRC Type 05-0700 gauge. If the sensitivity were specified at one milliampere emission, the sensitivity would be multiplied by 5 to give the sensitivity at 5 milliamperes. Then it would be divided into the 100 microampere/micron (Type 05-0700 sensitivity at 5 milliamperes) to get the multiplication factor. This can also be done by reducing the emission by the same proportion and then reading the gauge directly.

SECTION IV

MAINTENANCE

A. THERMOCOUPLE GAUGE CIRCUIT

The heater of the thermocouple operates in series with the TC ADJ control (9) and one resistor (R-12, Fig. II). An open circuit exists if the meter does not indicate filament current with a gauge in place with the METER SELECTOR (1) in the TC FIL position, and the rear switches as in Section III-B-1. If the meter reads when both rear switches (11) and (12) are in the ON position, but does not when a thermocouple gauge is connected (with its respective switch OFF) the open circuit is in the cord or gauge itself. A burned out thermocouple gauge filament may be found with an ohmmeter connected to terminals 1 and 5 of the gauge to give no indication when burned out. (Filament resistance is under one ohm in a good gauge). The cord connections should be checked for continuity if the filament is found to be in good shape with the ohmmeter. The thermocouple gauge will withstand a current of one ampere at atmospheric pressure without damage to the heater element.

B. IONIZATION GAUGE CIRCUIT

The ionization gauge control can be divided into two distinct parts: the ionization gauge filament control and the ionization current amplifier.

1. IONIZATION GAUGE FILAMENT CONTROL

The filament of the gauge is heated by the output of filament transformer T-1 (See Fig. II). The input to this transformer is regulated by a variable reactance element T-3 in series with the primary of the filament transformer T-1. This element, in turn, receives its regulating signal from an amplifier, V-6, and the signal from the ionization gauge grid current. The function of this circuit is to regulate the filament emission so that it remains at present values of 1, 5, or 10 milliamperes, depending on the GRID CURRENT switch (2) position. The regulator is phased so that an increase in emission in the gauge (due to a temperature or pressure change, etc.) will send a negative signal to the grid of V-6. This in turn decreases the current through V-6 and the DC winding of the variable reactance (T-3). As a result of this the AC windings in series with the filament transformer primary act as a larger impedance, and will take a larger portion of the voltage available for the filament than before the original increase in emission. The filament voltage decreases and brings the emission

back to the original value before the pressure change. This controlling action works instantaneously and continuously so there are no changes in emission during a pump-down cycle from 5×10^{-3} mm to 10^{-7} mm, or during gas bursts in the system.

Failure to obtain required emission even with the emission adjust control turned to maximum position may be remedied by one or more of the following:

a. Changing ionization gauge. (Poisoned filament may limit emission to a low value.)

b. Shunting R-11 with a 10K 1 watt resistor. R-11 is located behind the panel above the chassis mounted on the rear of the grid current switch. (2)

2. IONIZATION CURRENT AMPLIFIER

The sensitivity of the ionization current amplifier has been set at the factory and the adjustment of the SENSITIVITY CONTROL (10) at the rear of the chassis should not be changed. If its setting is to be checked, follow the procedure outlined in Section III-C-4. The type of amplifier used automatically compensates for changes in supply voltage. In operation a one-volt signal on the input grid of V-4 gives a full scale indication on the meter in the ION PLATE position. The full scale ionization currents on the five ranges are 5×10^{-4}, 10^{-5}, 10^{-6} and 10^{-7} amperes. On the 10^{-6} mm range (10^{-7} amp. full scale) the input resistance to the amplifier is 10^{7} ohms. This requires a special shielded low-leakage ionization gauge cord. Even with this, the leakage signal may be of the order of 10 per cent of full-scale deflection and must be balanced out on this scale position as in Section III-C-3 before an accurate measurement of pressure can be taken. If it is impossible to zero balance the amplifier (probably due to a large leakage signal), the following checks should be made:

a. Disconnect the ionization gauge cord at the chassis and try to zero set the amplifier on the 10^{-6} range. If it can be balanced with the cord disconnected and cannot with the cord in place, disconnect the cord at the gauge and again try to balance the amplifier. If it can still be balanced without the gauge connected, but with the cord connected to the chassis, the leakage is in the gauge. Clean the base thoroughly. If the cord seems to be at fault, measure the leakage from the plate terminal (marked P) to the shield and other pins. Disconnect the cord completely for this test. Leakage resistance should be over ten thousand megohms. If it

is not, clean the bakelite plug assembly. If this does not improve the situation, replace the cord.

b. If in (a) above the leakage still persists when the cord is removed, the leakage is in the chassis receptacle, the control wiring, the tube socket, or tube V-4 itself. The leakage of a bad tube can be measured with a megohmmeter by removing the tube after it has been well warmed up and by quickly measuring the leakage from Pin No. 1 to any of the other pins, before it can cool. All readings should be over 10,000 megohms. Leakage in the tube may also be found by substituting a new tube (V-4) in the unit. Further difficulties should be referred to the factory.

3. REPLACING 6J6 METER AMPLIFIER TUBE

In some cases it may be necessary to select a fairly well balanced tube. It is simply necessary to plug in a tube and adjust the meter to zero with the ION ADJ control. If the meter will zero the tube is satisfactory (meter selector on ION PLATE).

Turn the RELAY ADJ control on the back counterclockwise to the limit. Apply 1.5 volts (flashlight cell) to the plate (+) and shield (-) at the ion gauge tube (operating) and with the range selector in any position but CAL. Turn the RELAY ADJ control slowly clockwise until the relay trips. Lock the control in this position. Remove the battery.

Zero the meter and switch to CAL. Adjust the meter reading by the METER SENS control on the back to the voltage stamped on the back of the chassis. The zero should be checked again and the CAL reading readjusted if necessary.

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CBS:pb
Revised 20 February 52

REPLACEMENT PARTS LIST

Type 07-1030 Gauge

Part No.	Sym.	Name	Description
07-015	R-1	Potentiometer	0.5 Megohm, 1 watt
07-135	R-2	Potentiometer	25,000 ohm, 1/2 watt
07-017	R-3	Potentiometer	30 ohm, 2 watt
07-136	R-4	Resistor-Vari.	5,000 ohm, 10 watt
07-020	R-6	Resistor	300 ohm, 1 watt ± 1%
07-137	R-7 & 8	Resistor	10,000 ohm, 1 watt ± 10%
07-022	R-9	Resistor	33,000 ohm, 1 watt ± 10%
07-023	R-10	Resistor	1,000 ohm, 1 watt ± 10%
07-024	R-11	Resistor	5,000 ohm, 1 watt ± 10%
07-138	R-12	Resistor-Fixed	10 ohm, 10 watt
07-139	R-13	Resistor	15,000 ohm, 1 watt ± 10%
07-027	R-14	Potentiometer	10,000 ohm, 1 watt
07-028	R-15	Potentiometer	6 ohm, 4 watt
07-029	R-16	Potentiometer	25 ohm, 1.5 watt
07-030	R-17	Resistor	120,000 ohm, 1 watt ± 1%
07-031	R-18	Resistor	10,000 ohm, 1 watt ± 10%
07-032	R-19	Resistor	10 Megohm, 1 watt ± 1%
07-033	R-20	Resistor	1 Megohm, 1 watt ± 1%
07-034	R-21	Resistor	100,000 ohm, 1 watt ± 1%
07-035	R-22	Resistor	10,000 ohm, 1 watt ± 1%
07-036	R-23 & 28	Resistor	2,000 ohm, 1 watt ± 1%
07-037	R-24 & 30	Resistor	0.47 Megohm, 1 watt ± 10%
07-023	R-25 & 26	Resistor	1,000 ohm, 1 watt ± 10%
07-038	R-27	Potentiometer	20,000 ohm, 2 watt
07-039	CR-1	Rectifier	Germanium Diode
07-040	C-1	Condenser	8 Mfd. 600 v.
07-041	C-2	Condenser	50 Mfd. 50 v.
07-042	C-3	Condenser	25 Mfd. 25 v.
07-043	T-1	Trans.-Fil.	6.3 v. @ 6a., 5 v. @ 6 a.
07-044	T-2	Trans.	700 v. @ 120 ma., 5 v. @ 3a., 6.3 v. @ 4.7a.
07-140	T-3	Reactor	Saturable Core
07-046	K-1	Relay	4PDT - 6 vac.
07-047	K-2	Relay	1,000 ohm - Sigma Type 4R
07-048	V-1 & 2	Tube	OD3/VR-150
07-049	V-3	Tube	5W4
07-141	V-4	Tube	6J6 - RCA or Raytheon*

* These tubes are supplied in matched pairs having similar characteristics.

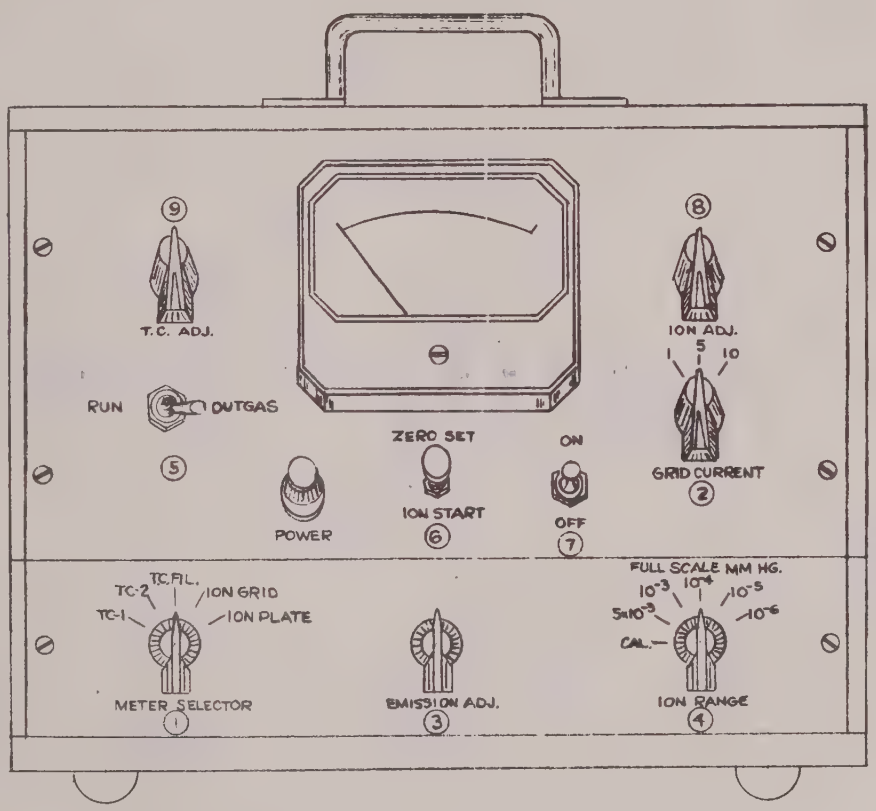
Part No.	Sym.	Name	Description
07-051	V-6	Tube	6AK6
07-052	F-1	Fuse	3a., 125 v.
07-142		Fuse Holder	
07-053	I-1	Pilot Lamp	#47 Lamp
07-054	M-1	Meter	200 Microamperes DC 55 ohm
07-056	S-2 & 3	Switch	125 v. @ 3a. SPST
07-057	S-4	Switch	4PDT 125 v. @ 6a.
07-058	S-5	Switch	Momentary Contact - Black Button, 125 v. @ 3a.
07-014	S-6	Switch	Toggle DPST 125 v. @ 3a.
07-059	S-7	Switch	Selector 1 Pole, 6 Position
07-060	S-8	Switch	Selector 2 Pole, 5 Position
07-059	S-9	Switch	Selector 1 Pole, 6 Position
07-061		Power Cord	110 v., 10a.,2 conductor 6 ft. lg.
07-062	R-29	Resistor	0.1 Meg. 1 watt ± 10%
9-05020-08		Ion Gauge Cord	
05-0700		Ion Gauge	
9-05020-01		TC Gauge Cord	
05-0100		TC Gauge	
07-126	R-32	Resistor	1,000 ohm, 1 watt ± 10%
07-143	X1-2-3-5-7	Socket Tube	Octal Amphenol 78-S8
07-144	X7-11	Socket Tube	5 Prong Amphenol 78-S5
07-145	X9-10	Socket Tube	4 Prong Amphenol 78-S4
07-146	X4-6-8	Socket Tube	7 Prong Bakelite Amphenol 78-7P
07-147	V-7	Tube	VR-75
07-148	V-8	Tube	OB2
07-149	R-34	Resistor	2 ohm 2 watt ± 10%
07-150	R-35	Resistor	4000 ohms 10 watt
07-151	R-37	Potentiometer	500 ohms 1/2 watt ± 10%
07-152	C-4	Condenser	16 Mfd. 450 DCWV
07-153	R-31	Resistor	27,000 ohms 1 watt ± 10%

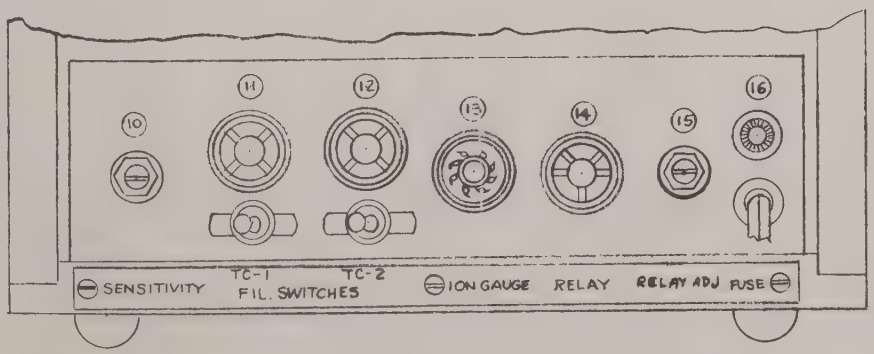
CBS:ml
Revised 27 June 1952

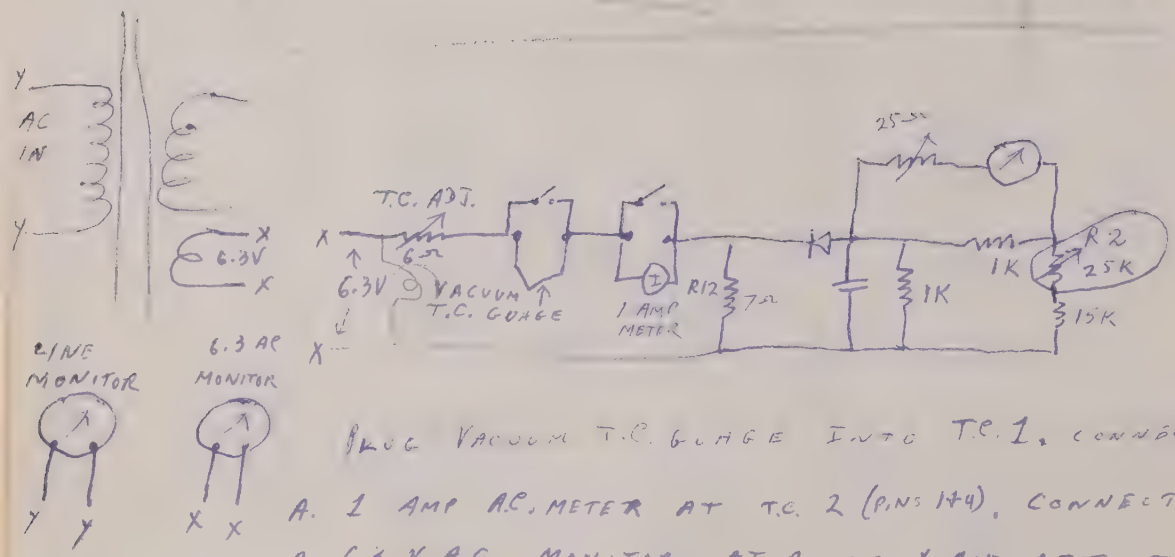
REVISION					Sheet of	Dwg. No. M-18049
DATE						

NATIONAL RESEARCH CORPORATION
70 Memorial Drive
Cambridge 42, Massachusetts

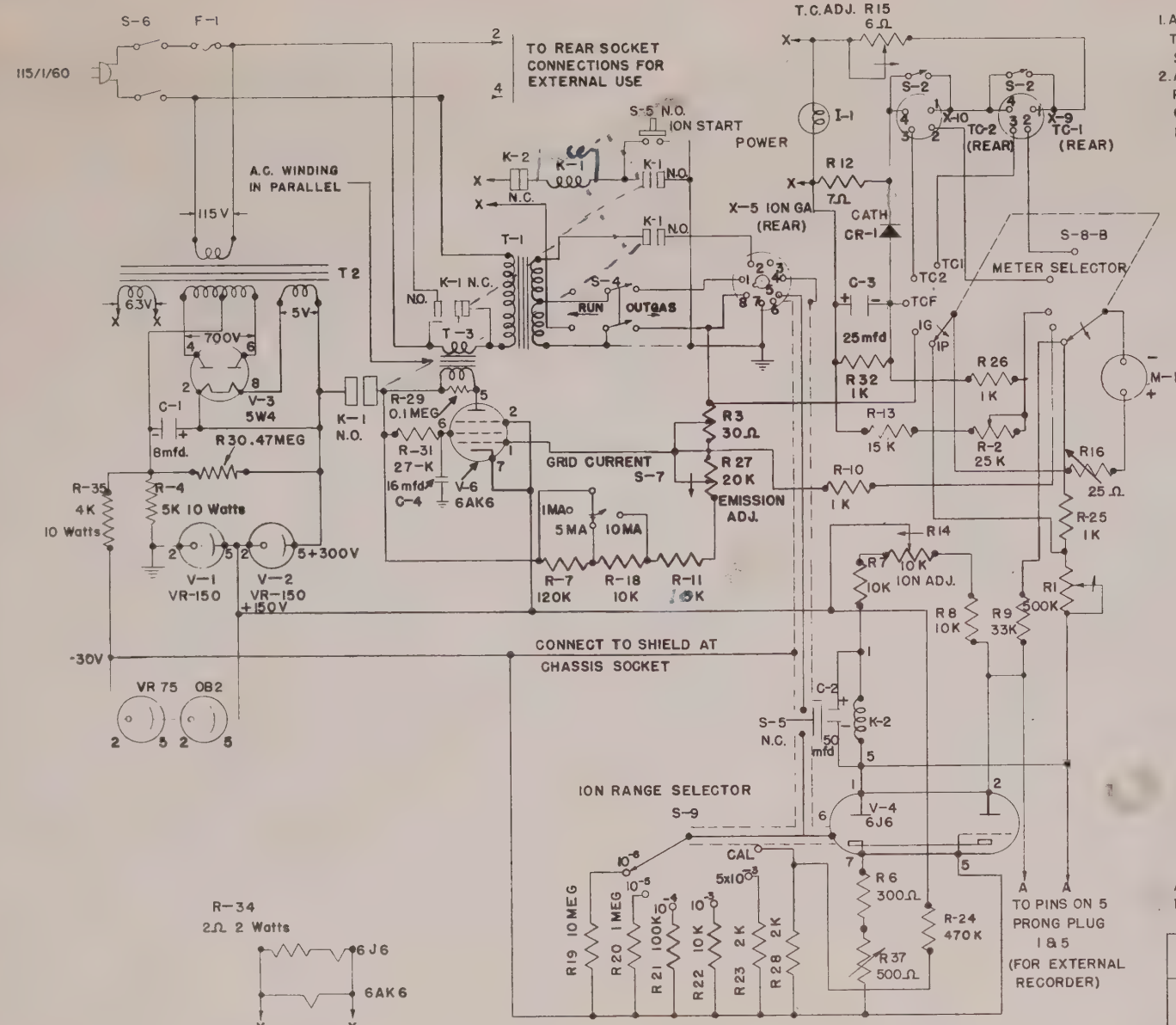
FIG I
PANEL & CHASSIS CONTROLS
TYPE-07-1031 GAUGE



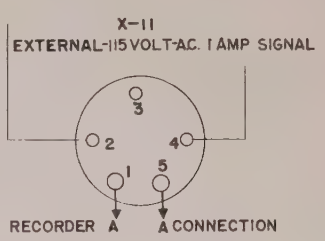


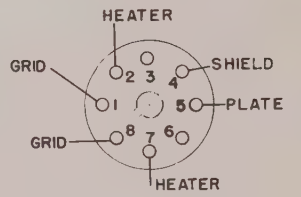


BLOG VACUUM T.C. GUAGE INTO T.C. 1. CONNECT A 1 AMP A.C. METER AT T.C. 2 (PINS 1+4). CONNECT A 6.3 V A.C. MONITOR AT POINTS X AND ADJUST FOR EXACTLY 6.3 V. ADJUST R2 SO THAT BOTH CURRENT METERS READ THE SAME

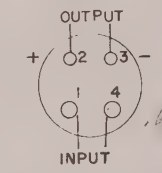


1. ALL VOLTAGES WITH RESPECT TO GROUND UNLESS OTHERWISE SHOWN
2. ARROWS ON SWITCHES AND POTENTIOMETERS INDICATE CLOCKWISE ROTATION LOOKING FROM SHAFT ENDS





CHASSIS ION GAUGE SOCKET



T. C. SOCKET

ALL SOCKETS SHOWN LOOKING FROM INSIDE CHASSIS

NATIONAL RESEARCH CORP. EQUIPMENT DIVISION				
FIG II WIRING DIAGRAM TYPE 07—1030 GAUGE				
SCALE		DATE	ENGINEERING	PROD.
ST.BY.	A.C.D	2/25/52	C.B.S.	K.M.B.
FIN.BY	A.C.D	2/27/52	6/27/52	
TR.BY			M-18050	
CH.BY	J.R.	3/20/52		

RECORDER CONNECTION TO TYPE 07-1031 THERMOCOUPLE IONIZATION GAUGE CONTROL

I. Recorder Specification and Connection

A recorder having the following specifications can be connected to the Type 07-1031 Thermocouple Ionization Gauge Control:

Full Scale Calibration: One (1) Milliampere
Input Impedance: 1400 Ohms minimum

The recorder should be connected to terminals 5 and 2 of the type 6J6 amplifier tube, positive on terminal 2. A 1,000 ohm potentiometer should be connected in series with the recorder in order to adjust the output signal from the 07-1031 gauge.

II. Calibration

1. Balance the amplifier as shown in the instructions for the Type 07-1031 Gauge, Page 9.

2. Set the range switch (4) on CAL, the METER SELECTOR (1) to ion plate. Set the 1,000 ohm potentiometer so the recorder reads the same as the CAL voltage stamped on the back of the chassis. (If the voltage stamped on the back is .67, the recorder should read .67 x full scale.)

3. Set the sensitivity adjustment (1·0) at the rear of the chassis so the meter reads the same as the recorder.

It is possible with some units that the output from the 07-1031 Gauge is not sufficient to operate the recorder. This is usually caused by a high setting of the overload relay. In this case adjust R-6 so that the overload relay shuts off the ionization gauge at a lower pressure. If this resistor is adjusted so that the relay cuts out at approximately 1.5 x the full scale reading on any scale (as received from the factory) there should be sufficient signal from the 6J6 to operate the recorder. If readjustment of this resistor does not give the required output, it may be necessary to replace the 6J6 tube.

CBS:ml
April 3, 1952